ARUP

Electric Hydrogen (EH2)

33 Jackson Devens Fit-out

Hazardous Materials Section 414 Report

Reference:

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1. Introduction

The following report documents the hazardous materials strategy for the Electric Hydrogen Co. (EH2) fit-out at 33 Jackson Rd. in Devens, MA, in accordance with the requirements of the Massachusetts State Building Code Section 414.1.3.

1.1 Building Description

33 Jackson Rd. is a two-story building that has been recently constructed in Devens, MA. The building will be occupied by EH2 to be used for light manufacturing and good manufacturing practices (GMP). The building is comprised of approximately 194,178 sf of total gross floor area. The floor areas of each floor are presented in Table 1. The building is currently fully protected by an automatic sprinkler system which will be retained and modified as part of the scope of work.

Table 1: 33 Jackson Devens Rd. Floor Areas

Floor	Approximate Floor Area (ft^2)
Level 1	124,717
Level 2	69,461
Building Total	194,178

An arial view of the building is provided in Figure 1. Directional references throughout this report utilize true North as depicted in the figure.

Figure 1: 33 Jackson Rd. Aerial View

This Hazardous Materials Section 414 report is written on behalf of EH2, the building tenant.

1.2 Scope of Work

The scope of work for this EH2 Fit-out project entails fitting out the full existing core and shell space with a mix of electrolyzer manufacturing/assembly, QA/QC testing, and office use spread across Levels 1 and 2. The scope of work on Level 1 includes the fit-out of manufacturing spaces and miscellaneous storage for hazardous materials. The scope of work on Level 2 primarily involves laboratory support processes for the electrolyzer assembly and office and conference spaces. It is assumed that existing conditions as they relate to the fit-out are equivalent to the conditions at the end of the Core and Shell project.

The project will be split into two permitting phases:

- Early Manufacturing Phase 0
- Full Program Phase 1

This report is based on hazardous material quantities required for Phase 1 and floor plans provided to Arup on November 8, 2023.

1.3 Applicable Codes and Standards

The following lists the Codes and Standards applicable to the project.

- 780 CMR – 9th Edition, Massachusetts State Building Code (MSBC), based on the 2015 International Building Code with MA amendments

- 527 CMR 1.00 – Massachusetts Comprehensive Fire Safety Code (MFSC), based on NFPA 1 Fire Code, 2021 Edition with MA amendments
- 527 CMR 12.00 – Massachusetts Electrical Code (MEC), based on NFPA 70 National Electrical Code, 2023 Edition with MA amendments
- 780 CMR 13.00 – Massachusetts Energy Efficiency Regulations, based on the 2018 International Energy Efficiency Code (IECC) with MA amendments
- 225 CMR 23.00 – Massachusetts Stretch Energy Code, based on the 2021 International Energy Conservation Code (IECC) with MA amendments
- 248 CMR – Massachusetts Fuel Gas and Plumbing Code, 2016 Edition
- 524 CMR – Massachusetts Elevator Regulations (for new construction, based upon the 2013 ANSI/ASME A17.2 Safety Code for Elevators and Escalators)
- 521 CMR – Massachusetts Architectural Access Board (MAAB) Regulations, 2006
- Americans with Disabilities Act Accessibility Guidelines, 2010 (ADA)
- National Fire Protection Association Standards as referenced in 780 CMR and 527 CMR:
  - NFPA 2 – Hydrogen Technologies Code, 2020 Edition
  - NFPA 10 – Standard for Portable Fire Extinguishing Systems, 2013 Edition
  - NFPA 13 – Standards for the Installation of Sprinkler Systems, 2013 Edition
  - NFPA 25 – Standard for Inspection, Testing, and Maintenance of Water-based Fire Protection Systems, 2014 Edition
  - NFPA 30 – Flammable and Combustible Liquids Code, 2021 Edition
  - NFPA 55 – Compressed Gases and Cryogenic Fluids Code, 2020 Edition
  - NFPA 70 – National Electrical Code, 2023 Edition
  - NFPA 72 – National Fire Alarm and Signaling Code, 2013 Edition
  - NFPA 110 – Standard for Emergency and Standby Power Systems, 2013 Edition
  - NFPA 400 – Hazardous Materials Code, 2019 Edition
  - NFPA 484 – Standard for Combustible Metals, 2019 Edition

Additional codes and standards may apply to the process design of hydrogen systems. It is the responsibility of the process designer to identify and ensure compliance with these codes and standards. Further information is provided in Section 6 below, “Hydrogen Generation Systems”.

1.3.1 10th Edition Massachusetts Codes

The Massachusetts Board of Building Regulations & Standards (BBRS) is currently in the process of adopting modified versions of the 2021 ICC codes for the 10th Edition of the Massachusetts State Building Code. At the time of this report, the 10th Edition of the Massachusetts State Building Code has not yet been approved for use. The BBRS hopes to adopt the 10th Edition by late-2023, however specific dates for code adoption have not yet been given. The following codes will be amended and adopted as part of the 10th Edition:

- International Building Code (IBC), 2021 Edition

- International Existing Building Code (IEBC), 2021 Edition
- International Energy Conservation Code (IECC), 2021 Edition

Based on the current project schedule, it is anticipated that the fit-out will be permitted under the 9th Edition of the Massachusetts State Building Code.

2. Key Issues

2.1 Control Areas and Group H Occupancies

The building's hazardous materials strategy will utilize a mix of control areas and Group H occupancies. As the building will be utilized for electrolyzer manufacturing, primary hazardous materials expected within the building include Class I flammable liquids, flammable gases, oxidizing gases, and flammable solids. These materials are further described within Section 4, Hazardous Materials.

The quantity of flammable solids on site will exceed the maximum allowable quantities (MAQs) for a single control area. Therefore, a Group H-3 occupancy will be required for the storage of flammable solids.

All other materials will be used and stored within control areas. The building will contain the following control areas and Group H occupancies:

- Control Area 1 – Dedicated flammable liquid storage room for Class I flammable liquid storage.
- Control Area 2 – Remainder of the building, to include both Level 1 and Level 2.
- Group H-3 Storage Room – Dedicated flammable solid storage room for titanium powder storage.

2.2 Accessory Group H Occupancies

The EH2 fit-out will include construction of a Group H-3 storage room designed for the storage of flammable solids. The Group H-3 room is limited to less than 10% of the total gross floor area and is therefore considered an accessory occupancy to the primary Group F/S occupancy.

2.3 Hydrogen Generation Systems

There are four MK4 electrolyzer testing stations planned for the Phase 1 fit-out, located in North and South rooms at the perimeter of the building. Each room will house two MK4 testing stations.

Hydrogen generation systems are required to be designed in accordance with NFPA 2, as referenced by the MFSC §63.8 for hydrogen generation systems. The aggregate volume of hydrogen contained to the MK4 testing stations is roughly 85ft^3, less than the 2,000ft^3 MAQ for flammable gas within the control area.

The primary safety system provided for the MK4 testing station rooms will be an emergency purge exhaust system interlocked to activate on hydrogen gas detection within the room. Features of this system are further described in Section 6, “Hydrogen Generation Systems”.

2.4 NFPA 45 Applicability

NFPA 45 is applicable to projects in Massachusetts that contain hazardous materials. The standard does not apply to the following uses *[NFPA 45 §1.1.3(4)]*:

- Laboratories that are primarily manufacturing plants

As the laboratory spaces within the EH2 fit-out will be used to support the electrolyzer manufacturing and assembly process, NFPA 45 does not apply to the project.

3. Flammable Materials Permits and Licenses

3.1 Flammable License

MGL Chapter 148 and the MFSC require a land license to be held by the owner (King Street Properties) for sites that use or store greater than or equal to the following thresholds of flammable materials:

Table 2: MFSC Table 1.12.8.50 Flammable License Thresholds

Material	Flammable License Threshold
Class I Flammable Liquids Indoors Outdoors	 ≥ 793 gallons ≥ 10,000 gallons
Class II Combustible Liquids	≥ 10,000 gallons
Class IIIA Combustible Liquids	≥ 10,000 gallons
Class IIIB Combustible Liquids	≥ 10,000 gallons
Fuel oil, indoors	≥ 10,000 gallons
Flammable Solids	≥ 100 lbs
Flammable Gases Indoors Outdoors	 ≥ 3,000 cu.ft ≥ 10,000 cu.ft

This license will be granted by the Devens Enterprise Commission.

Based on the expected flammable liquid and flammable solid quantities in the EH2 fit-out design, it is expected that the 793-gallon threshold for Class I flammable liquid indoor usage and storage, as well as the 100lb threshold for flammable solid usage and storage, will be exceeded.

3.2 Hazardous Materials Storage Permit

Per MFSC Table 1.12, EH2 is required to apply for and hold a hazardous materials storage permit with quantity limits that fall below the 33 Jackson Rd. license maximum. The Devens Fire Department reviews and grants storage permits, which are renewed annually.

3.3 Hazardous Materials Processing Permit

Per MFSC Section 60.8, EH2 is required to apply for and hold a hazardous materials processing permit. Categories on the processing permit are based on container/vessel volumes and occupancy classification. Any Group H occupancy falls into Category 3, independent of container/vessel size; however, as the Group H-3 occupancy will be used purely for the storage of material, it is not expected that a Category 3 process permit will be required for this space.

Processing outside of the Group H-3 storage room that utilizes containers or vessels larger than 60-gallons will require a Category 3 processing permit.

4. Hazardous Materials

The following section outlines the primary hazardous material quantities are anticipated in the EH2 fit-out. The information is based on received chemical quantities and inventories from EH2. It is understood that the quantities listed below support having a 3-month supply of materials on hand and simultaneous operation of all four MK4 electrolyzer testing stations.

Table 3: EH2 Hazardous Materials – Indoor

Material	Classification
Isopropyl alcohol (IPA)	Flammable Liquid – Class IB
Methyl Ethyl Ketone (MEK)	Flammable Liquid – Class IB
Ethyl Acetate (EA)	Flammable Liquid – Class IB
Hydrogen (gaseous) [+]	Flammable gas
Oxygen (gaseous)	Oxidizing gas
Titanium powder (≤ 50 µm particle size)	Flammable solid
Platinum on Carbon Black	Flammable solid
Iridium (IV) Oxide	Oxidizer – Class 3
Waste – IPA <10%	Flammable Liquid – Class IC *
Waste – EA <5%	Flammable Liquid – Class IC *
Waste – MEK <5%	Non-hazardous *

*See Section 4.1, Dilute Aqueous Waste Streams.

Note that the materials summarized above are the primary hazardous materials expected for the fit-out. A complete chemical inventory will be expected to be submitted to the Devens Fire Department in support of the hazardous materials storage permit and hazardous materials processing permit for the project.

4.1 Dilute Aqueous Waste Streams

At the time of this report issuance there are three potential waste streams associated with the EH2 processes:

1. Water and IPA < 10% with trace amounts of platinum and graphite
2. Water and MEK < 5% with trace amounts of titanium
3. Water and EA < 5% with trace amounts of titanium

Dilute solvent mixtures with flash points greater than 100°F are classified as Class II, IIIA, and IIIB Combustible Liquids. Additionally, if the solutions are not able to sustain combustion when ignited or do not have a fire point, they are exempt from the requirements of NFPA 30 *[NFPA 30 §1.1.2(12)]*.

EH2 has sought flash point and sustained combustion testing to confirm the classification for the Water and < 10% IPA and Water and < 5% MEK aqueous mixtures. The following results were observed. Complete test results can be found in Appendix B of this report.

1. Water and IPA < 10% with trace amounts of platinum and graphite
    a. Flash point = 96.8°F
    b. Sustains combustion when ignited
2. Water and MEK < 5% with trace amounts of titanium
    a. Flash point = 60.8°F
    b. Does not sustain combustion when ignited

The Water and < 10% IPA mixture is classified as a Class IC flammable liquid.

It is proposed to treat the Water and < 5% MEK mixture as non-hazardous in accordance with the compliance path outlined above as the material does not have a *fire point* and will not sustain combustion when ignited.

EH2 is in the process of seeking flash point and sustained combustion testing for the Water and < 5% EA waste stream to confirm the classification for these aqueous mixtures. For the purposes of this report and the hazardous materials strategy for the fit-out, the Water and < 5% EA waste stream is assumed to be a Class IC flammable liquid.

4.1.1 Compliance Path

Aqueous solutions that do not have a *fire point* when ignited are exempt from the requirements of Chapter 66 of the MFSC for Flammable and Combustible liquids, and NFPA 30 *[MFSC §66.1.3; NFPA 30 §1.1.2(12)]*. The *fire point* is defined as "the lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame in accordance with ASTM D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester."

- **MFSC §66.1.3.** This chapter shall not apply to the following:

  …

  (11) Liquids that have no fire point when tested in accordance with ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, up to the boiling point of the liquid or up to a temperature at which the liquid shows an obvious physical change.

- **NFPA 30 §1.1.2.** This code shall not apply to the following:

  …

  (11) Liquids that have no fire point when tested in accordance with ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, up to the boiling point of the liquid or up to a temperature at which the liquid shows an obvious physical change.

It is noted that the upcoming 10th Edition of the Massachusetts State Building Code, available in draft format online[1], includes the following exceptions to the definition of Combustible Liquids:

- **EXCEPTIONS**: The category of combustible liquids shall not apply to:

  …

  Class II and III liquids that are not heated to or above their flash points and:

[1] https://www.mass.gov/doc/10th-edition-total-version-1213/download

- that have no fire point when tested in accordance with ASTM D92, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change; or
- that are in a water-miscible solution or in a dispersion with a water and inert (noncombustible) solids content of more than 80% by weight, which do not sustain combustion when tested using 49 CFR 173 Appendix H or the UN Recommendation on the Transport of Dangerous Goods.

It is proposed to treat the Water and < 5% MEK mixture as non-hazardous in accordance with the compliance path outlined above as the material does not have a *fire point* and will not sustain combustion when ignited.

4.2 Combustible Dust

Titanium powder at particle sizes of 50 µm or less and Platinum on Carbon Black are utilized in the processes. Both materials are noted as a potential combustible dust on the Safety Data Sheet, provided in Appendix B. It is the responsibility of EH2 to conduct a Dust Hazard Assessment (DHA) in accordance with MFSC §40.1.1 and NFPA 652, *Standard on the Fundamentals of Combustible Dust*, 2019 Edition. Owners and operators of facilities where materials determined to be combustible or explosible in accordance with Chapter 5 of NFPA 652 are present in an enclosure shall be responsible to ensure a DHA is completed in accordance with the requirements of the Code [*MFSC §40.5.1.2*].

Through discussions with EH2 we understand that a DHA will be completed prior to start-up of the powder-handling processes.

5. Storage and Use Provisions

EH2's fit-out at 33 Jackson Rd. will involve the storage and use of hazardous materials. Where the quantity of material exceeds the limitations of the MSBC Tables 307.1(1) and 307.1(2) as adjusted by MSBC Table 414.2.2, the classification of the space becomes High-Hazard Group H.

The quantity of titanium powder, a flammable solid, will exceed the MAQs for a single control area. Therefore, a Group H-3 occupancy will be required for the storage of flammable solid.

All other materials will be used and stored within control areas. The building will contain the following control areas and Group H occupancies:

- Control Area 1 – Dedicated flammable liquid storage room for IPA and MEK storage.
- Control Area 2 – Remainder of the building, to include both Level 1 and Level 2.
- Group H-3 Storage Room – Dedicated flammable solid storage room for titanium powder storage.

The hazardous materials stacking diagram for the building is depicted below and shows the intended control areas and Group H occupancies within the building.

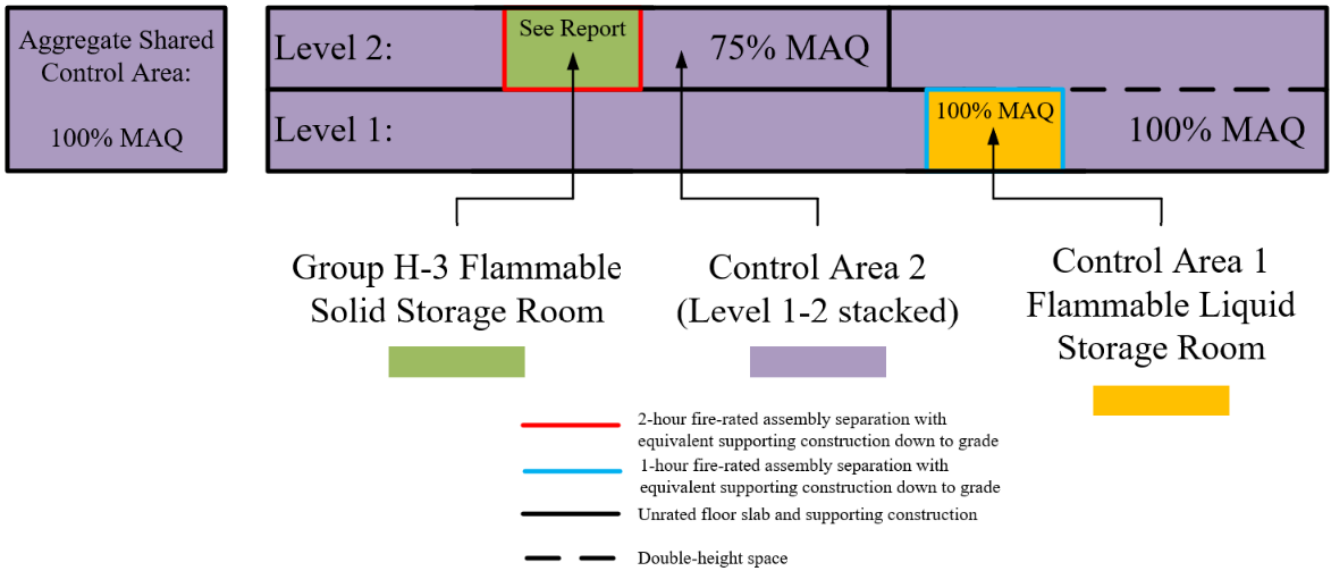

Figure 2: EH2 Hazardous Materials Stacking Diagram

5.1 Control Areas

For control areas to be established on each floor of a two-story Type IIB building, a minimum fire-resistance rating of 2-hours is required for the floor slab and supporting construction for floors supporting control areas *[MSBC §414.2.4]*. The unrated construction of 33 Jackson does not support establishing separate control areas on Level 1 and Level 2 of the building; therefore, the project will utilize a shared control area for the majority of the building. The slab on grade adheres to the requirement to provide 2-hour construction for the bottom of the control area.

For shared control areas, the aggregate quantity of materials within the shared control area is limited to the MAQs of the lowest level of the control area, 100% of the MAQs presented in MSBC Tables 307.1(1) and (2) for Level 1. Material quantities on each level are individually limited to what is permitted for that level.

Table 4 shows the adjustments made to the MAQs of MSBC Tables 307.1(1) and (2) based on location of storage and/or usage on Level 1 and Level 2 of the building.

Table 4: Excerpt of MSBC Table 414.2.2

Floor Level	% of MAQ per Control Area	Fire-Resistance Rating to Separate Control Areas
Level 1	100	1
Level 2	75	1

Table 5 provides the MAQs for Class IB and IC flammable liquids, flammable solids, flammable gases, and oxidizing gases, the primary material classifications associated with the EH2 fit-out. See Appendix A for a complete MAQ summary for both control areas.

Table 5: Maximum Allowable Quantities of Hazardous Materials [a]

Level	Material Classification	Storage	Closed Use	Open Use
Level 1 [b]	Class IB & IC Flammable Liquids	480 gal [c]	240 gal	60 gal
	Flammable Solids	500 lb [c]	250 lb	50 lb
	Flammable Gases	2,000 ft^3	2,000 ft^3	N/A
	Oxidizing Gases	3,000 ft^3	3,000 ft^3	N/A
Level 2 [b]	Class IB & IC Flammable Liquids	360 gal [c]	180 gal	45 gal
	Flammable Solids	375 lb [c]	187.5 lb	37.5 lb
	Flammable Gases	1,500 ft^3	1,500 ft^3	N/A
	Oxidizing Gases	2,250 ft^3	2,250 ft^3	N/A

Table Notes:

[a] The aggregate quantity of material in use and storage shall not exceed the MAQ listed for storage

[b] The aggregate quantity of materials within Control Area 2, the shared control area, is limited to 100% of the MAQs presented in the table for Level 1. Material quantities on Level 2 are individually limited to what is permitted for Level 2.

[c] The MAQ listed for Storage includes the 100% increase permitted for fully sprinklered buildings and the 100% increase permitted for approved storage. **All** stored materials of this material classification within the control area must be within approved cabinets to apply the increase.

6. Hydrogen Generation Systems

There are four MK4 electrolyzer testing stations planned for the fit-out, located in North and South rooms at the perimeter of the building. Each room will house two MK4 testing stations.

Hydrogen generation systems are required to be designed in accordance with NFPA 2, as referenced by the MFSC §63.8 for hydrogen generation systems. The aggregate volume of hydrogen contained to the MK4 testing stations is roughly 85ft^3, less than the 2,000ft^3 MAQ for flammable gas within the control area.

The primary safety system provided for the MK4 testing station rooms will be an emergency purge exhaust system interlocked to activate on organic vapor detection within the room. As required by NFPA 2 §13.3.1.2, the ventilation system will be provided with the following features:

- Loss of mechanical ventilation will be interlocked to shut down power to all MK4 systems within the room, stopping gas generation.
- Gas detectors calibrated for hydrogen will be located at ceiling level and will be interlocked to shut down power to all MK4 systems within the room, stopping gas generation, upon detection of 5% LEL. The emergency purge exhaust system will be activated upon detection of 10% LEL.
- The purge ventilation rate will be designed to exhaust the maximum anticipated hydrogen leak as determined by EH2.

- The purge ventilation rate will be designed to prevent oxygen-enriched atmosphere (23.5% O_2 or above) in the room in the event of an oxygen leak into the room, as determined by EH2.
- The emergency purge exhaust system will terminate to the exterior of the building as follows:
  - Minimum 30ft from property lines
  - Minimum 10ft from operable building openings
  - Minimum 10ft from operable building openings in the direction of exhaust discharge
  - Minimum 6ft from exterior walls and roofs
  - Minimum 10ft above adjoining grade

The MK4 testing rooms will be provided with smoke detection which will activate the emergency purge system.

6.1 Electrolyzer Testing Station Design

6.1.1 Applicable Codes and Standards

It is the responsibility of EH2 as the process designer to ensure compliance with codes and standards applicable to the process. Of note, the following codes and standards apply:

- ASME B31, Code for Pressure Piping *[NFPA 55 §10.2.2]*
- CGA G-5.5, Hydrogen-Venting Systems *[NFPA 55 §10.2.3]*
- CGA G-4.4, Oxygen Pipeline and Piping Systems *[ISO 22734 §4.1.5.2]*
- ISO 22734:2019, Hydrogen generators using water electrolysis – Industrial, commercial, and residential applications, or equivalent listing standard *[NFPA 2 §13.2.1]*

6.1.2 Risk Assessment

Electrolyzer manufacturers are required to perform a risk assessment on the hydrogen generator design using one or more structured techniques per IEC 31010:2019, Annex B (Risk management techniques), or the requirements of ISO 12100 (Risk assessment and risk reduction) *[ISO 22734 §4.2]*.

6.1.3 Process Vents

Process vents, including relief vents, are required to be terminated in accordance with the following separation distances *[NFPA 2 §6.17]:*

- Minimum 10ft above grade
- Minimum, 2ft above adjacent equipment
- Minimum 5ft above rooftops

Additional requirements for process vents are contained in CGA G-5.5 and ISO 22734:2019.

All hydrogen piping located indoors should be exposed and not covered by floors, walls, or ceilings. Piping should be readily visible and protected from physical damage where physical damage may occur.

6.1.4 Safeguards

Through discussion with EH2, we understand the system to incorporate the following primary interlocks:

- Pressures within the MK4s are monitored for deviations and are interlocked to shut down power to the system, stopping gas generation, if the process falls outside of the designated setpoints.
- Tests are automated and run from a programmable logic controller (PLC) which is provided with UPS power.
- Leak tests are conducted prior to start-up.
- Voltage tests are conducted prior to start-up. The test voltage is set lower than what is required to initiate electrolysis.
- Each MK4 is provided with dedicated hydrogen and oxygen process vents designed in accordance with nationally recognized CGA standards and are separated from one another to prevent cross-mixing of the exhaust streams.

7. Group H-3 Flammable Solid Storage Room

Storage of flammable solids is expected to exceed the MAQ for a single control area. Therefore, a Group H-3 flammable solid storage room will be established on Level 2 of the building.

The following section includes requirements from the MSFC, NFPA 400, NFPA 484, and MSBC Sections 414 and 415.

Storage of the following materials in quantities that exceed the MAQ are required to be within a High-Hazard Group H-3 occupancy:

- Combustible or flammable liquids, where stored in closed containers or in systems with pressures of 15 psi or below
- Flammable solids
- Cryogenic fluids, oxidizing
- Organic peroxides – Class II and III
- Oxidizers – Class 2
- Oxidizers – Class 3, where stored in closed containers or in systems with pressures of 15 psi or below
- Unstable reactive materials – Class 2
- Water reactive materials – Class 2

As the room is designed as a Group H-3 occupancy, certain classifications of materials are not permitted within the room when stored or used in quantities that exceed the associated MAQ. Materials classified by the MSBC as hazardous that are **not** listed above are not permitted to exceed the MAQs listed in 780 CMR Tables 307.1(1) and 307.1(2) within the Group H-3 room.

The EH2 Group H-3 storage room is intended to be used solely for the storage of flammable solids in amounts greater than the MAQ. Materials incompatible with titanium powder are not permitted to be stored within the same room unless they are stored in listed cabinets *[MFSC §60.5.1.12]*.

7.1 Group H-3 Construction

Group H-3 occupancies are required to be separated from adjacent occupancies by rated fire barriers in accordance with Table 6 *[MSBC Table 508.4]*.

Table 6: Group H-3 Fire Rated Separations

	Group H-3 Minimum Required Separation (hrs)
Group B, S-1, F-1	1
Group S-2	2
Group A	2

7.2 Fire Separation Distance

Group H-3 occupancies are required to have a minimum of 25% of their perimeter along an exterior wall of the building *[MSBC §415.6]*. Exceptions to this requirement are:

- Flammable / combustible liquid dispensing and storage rooms complying with NFPA 30 equal to or less than 500ft^2

As the room will not be utilized for flammable and combustible liquid storage, it is located such that a minimum of 25% of the room perimeter is along an exterior wall of the building.

7.3 Exterior Wall Ratings

Exterior wall ratings are determined based on the fire separation distance (FSD) between the building and nearby adjacencies. The FSD is defined as the distance from the building face to one of the following:

- The closest interior lot line
- The centerline of a street
- An imaginary line between two buildings on the lot

Exterior wall ratings for Group H occupancies are as follows *[MSBC Table 602]*:

Table 7: Exterior Wall Ratings for Group H Occupancies in Type IIB Buildings

Fire Separation Distance = X (ft)	Fire-resistance Rating of Exterior Group H Walls (hrs)
$X < 5$	3
$5 \leq X < 10$	2
$10 \leq X < 30$	1
$X \geq 30$	0

All property lines for the 33 Jackson Rd. building are greater than 30 feet away from the building. Therefore, unrated exterior walls are expected and are compliant with MSBC §602.

7.4 Fire Suppression

Automatic sprinkler protection is required for all Group H occupancies *[MSBC §415.4]*.

Group H-3 rooms storing flammable solids are to be designed to the minimum criteria for Extra Hazard Group 1 (EH1) per NFPA 13 for spaces containing large amounts of combustible contents *[NFPA 13 §5.4.1]*.

7.5 Specialty Detection and Alarm

Where emergency alarm systems are required, they must be provided with emergency or standby power and be electrically supervised and monitored at an approved location *[MSBC §415.5.4]*.

7.5.1 Automatic Smoke Detection

Where Group H occupancies contain highly toxic gases, organic peroxides, or oxidizers, they shall be provided with an automatic smoke detection system *[MSBC §907.3.5]*.

It is not expected that quantities of the material classifications listed above will exceed the MAQ in the Group H-3 storage room, so smoke detection is not required.

7.5.2 Emergency Hazardous Materials Alarm

The Group H-3 room is required to be provided with an emergency hazardous material alarm manual pull station located outside the room per MSBC §415.5.1. Activation of the alarm-initiating device will sound a local alarm to alert occupants of an emergency situation involving hazardous materials inside the Group H-3 room.

7.5.3 Emergency Alarm for Transport

The Group H-3 room is designed as an accessory occupancy in accordance with MSBC Section 508.2. As such, requirements applicable to Group H occupancies do not apply outside the boundaries of the Group H occupancy. Emergency alarms per MSBC §415.5.2 along routes of transport are not required.

However, hazardous materials will be transported through the building, and as such, EH2 should provide spill kits along the routes of transport capable of addressing a spill of flammable solid, the intended material for the Group H-3 storage room.

7.6 Explosion Control

Explosion control is not required for the storage of flammable solids in amounts greater than the MAQ per MSBC Table 414.5.1.

7.7 Hazardous Electrical Classification

Unclassified electrical equipment is appropriate for rooms storing flammable solids. If the use of flammable solids is expected within the room, additional electrical classification requirements may apply. See Section 4.1, Combustible Dust, for further discussion.

7.8 Spill Control and Secondary Containment

Spill control and secondary containment are not required for the storage of flammable solids in amounts greater than the MAQ per NFPA 400 §13.2.

Appendix A

Maximum Allowable Quantities of Hazardous Materials

A.1 Maximum Allowable Quantities

The following tables provide the Maximum Allowable Quantities of hazardous materials for each of the two control areas in the EH2 fit-out. The following allowances are applied:

- A 100% increase permitted for buildings equipped throughout with an automatic sprinkler system, in accordance with 780 CMR Table 307.1(1) footnote d, and Table 307.1(2) footnote d.
- A 100% increase permitted for hazardous materials stored in approved storage cabinets, gas cabinets, or exhaust enclosures, in accordance 780 CMR Table 307.1(1) footnote e, and Table 307.1(2) footnote e.

Note that **all** hazardous materials for which the approved storage increase is applied must be stored in approved cabinets or exhausted enclosures to apply this increase within the control area. If all hazardous materials within a hazard classification are not stored in approved cabinets or exhausted enclosures, the values highlighted in yellow in the tables must be halved.

As described in Section 5.1, Control Areas, the aggregate quantity of materials within the shared control area is limited to the MAQs of the lowest level within the control area, using the MAQs presented in MSBC Tables 307.1(1) and (2) as reference. In addition, material quantities on each level are individually limited to what is permitted for that level.

The following example is provided for Class IB and IC flammable liquids within Control Area 2:

Control Area 2 is shared between Level 1 and Level 2; therefore, the aggregate volume of Class IB and IC liquids permitted amongst both floors in the control area is 480 gallons, or 100% MAQ as applicable to Level 1, the lowest level within the shared control area. Level 2 is further limited to no more than 360 gallons for Class IB and IC flammable liquids, 75% MAQ.

If Level 2 contains a total of 360 gallons, Level 1 would only be permitted the remainder of the aggregate 480-gallon MAQ (480 – 360 = 120 gallons). As an alternative split, if Level 1 were to contain the entire 480 gallon limit, Level 2 would not be permitted to contain Class IB and IC flammable liquids.

These restrictions must be balanced amongst the materials within Control Area 2 spanning Level 1 and Level 2 of the building.

Control Area 1 - Level 1

Material	Class	Storage			Use - Closed Systems			Use - Open Systems	
		Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible fiber	Loose	(100)	N/A	N/A	(100)	N/A	N/A	(20)	N/A
	Baled	(1000)	N/A	N/A	(1000)	N/A	N/A	(200)	N/A
Combustible liquid	II	N/A	240	N/A	N/A	240	N/A	N/A	60
	IIIA	N/A	660	N/A	N/A	660	N/A	N/A	160
	IIIB	N/A	NL	N/A	N/A	NL	N/A	N/A	NL
Consumer fireworks	1.4G	(125)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cryogenics, flammable	N/A	N/A	90	N/A	N/A	90	N/A	N/A	20
Cryogenics, inert	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Cryogenics, oxidizing	N/A	N/A	90	N/A	N/A	90	N/A	N/A	20
Explosives	Division 1.1	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.2	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.3	5	(5)	N/A	1	(1)	N/A	1	1
	Division 1.4	50	(50)	N/A	50	(50)	N/A	N/A	N/A
	Division 1.4G	250	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Division 1.5	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.6	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flammable Gas	Gaseous	N/A	N/A	2000	N/A	N/A	2000	N/A	N/A
	liquefied	N/A	(300)	N/A	N/A	(300)	N/A	N/A	N/A
Flammable liquid	Class IA	N/A	60	N/A	N/A	60	N/A	N/A	20
	Class IB & IC	N/A	240	N/A	N/A	240	N/A	N/A	60
Flammable liquid, combination (1A, 1B, 1C)	N/A	N/A	240	N/A	N/A	240	N/A	N/A	60
Flammable solid	N/A	250	N/A	N/A	250	N/A	N/A	50	N/A
Inert gas	Gaseous	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
	Liquefied	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Organic peroxide	UD	1	(1)	N/A	0.25	(0.25)	N/A	0.25	(0.25)
	I	10	(10)	N/A	2	(2)	N/A	2	(2)
	II	100	(100)	N/A	100	(100)	N/A	20	(20)
	III	250	(250)	N/A	250	(250)	N/A	50	(50)
	IV	NL	NL	N/A	NL	NL	N/A	NL	NL
	V	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizer	4	1	(1)	N/A	0.25	(0.25)	N/A	0.25	(0.25)
	3	20	(20)	N/A	4	(4)	N/A	4	(4)
	2	500	(500)	N/A	500	(500)	N/A	100	(100)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizing Gas	Gaseous	N/A	N/A	3000	N/A	N/A	3000	N/A	N/A
	Liquified	N/A	(300)	N/A	N/A	(300)	N/A	N/A	N/A
Pyrophoric material	N/A	4	(4)	50	1	(1)	10	0	0
Unstable (reactive)	4	1	(1)	10	0.25	(0.25)	2	0.25	(0.25)
	3	10	(10)	100	2	(2)	20	2	(2)
	2	100	(100)	1500	100	(100)	1500	20	(20)
	1	NL	NL	NL	NL	NL	NL	NL	NL
Water reactive	3	10	(10)	N/A	10	(10)	N/A	2	(2)
	2	100	(100)	N/A	100	(100)	N/A	20	(20)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Corrosive	Gaseous	N/A	N/A	(1620)	N/A	N/A	(1620)	N/A	N/A
	Liquified/Solid	(10000)	(1000)	(300)	(10000)	(1000)	(300)	(2000)	(200)
Highly Toxic	Gaseous	N/A	N/A	NP	N/A	N/A	NP	N/A	N/A
	Liquified/Solid	(20)	(20)	NP	(20)	(20)	NP	(6)	(6)
Toxic	Gaseous	N/A	N/A	(1620)	N/A	N/A	(1620)	N/A	N/A
	Liquified/Solid	(1000)	(1000)	(300)	(1000)	(1000)	(300)	(250)	(250)

Notes:

N/A = Not applicable
NL = No Limit
UD = Unclassified Detonable
NP = Not Permitted

Control Area 2 - Level 1

Material	Class	Storage			Use - Closed Systems			Use - Open Systems	
		Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible fiber	Loose	(100)	N/A	N/A	(100)	N/A	N/A	(20)	N/A
	Baled	(1000)	N/A	N/A	(1000)	N/A	N/A	(200)	N/A
Combustible liquid	II	N/A	240	N/A	N/A	240	N/A	N/A	60
	IIIA	N/A	660	N/A	N/A	660	N/A	N/A	160
	IIIB	N/A	NL	N/A	N/A	NL	N/A	N/A	NL
Consumer fireworks	1.4G	(125)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cryogenics, flammable	N/A	N/A	90	N/A	N/A	90	N/A	N/A	20
Cryogenics, inert	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Cryogenics, oxidizing	N/A	N/A	90	N/A	N/A	90	N/A	N/A	20
Explosives	Division 1.1	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.2	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.3	5	(5)	N/A	1	(1)	N/A	1	1
	Division 1.4	50	(50)	N/A	50	(50)	N/A	N/A	N/A
	Division 1.4G	250	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Division 1.5	1	(1)	N/A	0.25	(0.25)	N/A	0.25	0.25
	Division 1.6	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flammable Gas	Gaseous	N/A	N/A	2000	N/A	N/A	2000	N/A	N/A
	liquefied	N/A	(300)	N/A	N/A	(300)	N/A	N/A	N/A
Flammable liquid	Class IA	N/A	60	N/A	N/A	60	N/A	N/A	20
	Class IB & IC	N/A	240	N/A	N/A	240	N/A	N/A	60
Flammable liquid, combination (1A, 1B, 1C)	N/A	N/A	240	N/A	N/A	240	N/A	N/A	60
Flammable solid	N/A	250	N/A	N/A	250	N/A	N/A	50	N/A
Inert gas	Gaseous	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
	Liquefied	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Organic peroxide	UD	1	(1)	N/A	0.25	(0.25)	N/A	0.25	(0.25)
	I	10	(10)	N/A	2	(2)	N/A	2	(2)
	II	100	(100)	N/A	100	(100)	N/A	20	(20)
	III	250	(250)	N/A	250	(250)	N/A	50	(50)
	IV	NL	NL	N/A	NL	NL	N/A	NL	NL
	V	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizer	4	1	(1)	N/A	0.25	(0.25)	N/A	0.25	(0.25)
	3	20	(20)	N/A	4	(4)	N/A	4	(4)
	2	500	(500)	N/A	500	(500)	N/A	100	(100)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizing Gas	Gaseous	N/A	N/A	3000	N/A	N/A	3000	N/A	N/A
	Liquified	N/A	(300)	N/A	N/A	(300)	N/A	N/A	N/A
Pyrophoric material	N/A	4	(4)	50	1	(1)	10	0	0
Unstable (reactive)	4	1	(1)	10	0.25	(0.25)	2	0.25	(0.25)
	3	10	(10)	100	2	(2)	20	2	(2)
	2	100	(100)	1500	100	(100)	1500	20	(20)
	1	NL	NL	NL	NL	NL	NL	NL	NL
Water reactive	3	10	(10)	N/A	10	(10)	N/A	2	(2)
	2	100	(100)	N/A	100	(100)	N/A	20	(20)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Corrosive	Gaseous	N/A	N/A	(1620)	N/A	N/A	(1620)	N/A	N/A
	Liquified/Solid	(10000)	(1000)	(300)	(10000)	(1000)	(300)	(2000)	(200)
Highly Toxic	Gaseous	N/A	N/A	NP	N/A	N/A	NP	N/A	N/A
	Liquified/Solid	(20)	(20)	NP	(20)	(20)	NP	(6)	(6)
Toxic	Gaseous	N/A	N/A	(1620)	N/A	N/A	(1620)	N/A	N/A
	Liquified/Solid	(1000)	(1000)	(300)	(1000)	(1000)	(300)	(250)	(250)

Notes:

N/A = Not applicable
NL = No Limit
UD = Unclassified Detonable
NP = Not Permitted

Control Area 2 - Level 2

Material	Class	Storage			Use - Closed Systems			Use - Open Systems	
		Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible fiber	Loose	(75)	N/A	N/A	(75)	N/A	N/A	(15)	N/A
	Baled	(750)	N/A	N/A	(750)	N/A	N/A	(150)	N/A
Combustible liquid	II	N/A	180	N/A	N/A	180	N/A	N/A	45
	IIIA	N/A	495	N/A	N/A	495	N/A	N/A	120
	IIIB	N/A	NL	N/A	N/A	NL	N/A	N/A	NL
Consumer fireworks	1.4G	(93.75)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cryogenics, flammable	N/A	N/A	67.5	N/A	N/A	67.5	N/A	N/A	15
Cryogenics, inert	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Cryogenics, oxidizing	N/A	N/A	67.5	N/A	N/A	67.5	N/A	N/A	15
Explosives	Division 1.1	0.75	(0.75)	N/A	0.1875	(0.1875)	N/A	0.1875	0.1875
	Division 1.2	0.75	(0.75)	N/A	0.1875	(0.1875)	N/A	0.1875	0.1875
	Division 1.3	3.75	(3.75)	N/A	0.75	(0.75)	N/A	0.75	0.75
	Division 1.4	37.5	(37.5)	N/A	37.5	(37.5)	N/A	N/A	N/A
	Division 1.4G	187.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Division 1.5	0.75	(0.75)	N/A	0.1875	(0.1875)	N/A	0.1875	0.1875
	Division 1.6	0.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flammable Gas	Gaseous	N/A	N/A	1500	N/A	N/A	1500	N/A	N/A
	liquefied	N/A	(225)	N/A	N/A	(225)	N/A	N/A	N/A
Flammable liquid	Class IA	N/A	45	N/A	N/A	45	N/A	N/A	15
	Class IB & IC	N/A	180	N/A	N/A	180	N/A	N/A	45
Flammable liquid, combination (1A, 1B, 1C)	N/A	N/A	180	N/A	N/A	180	N/A	N/A	45
Flammable solid	N/A	187.5	N/A	N/A	187.5	N/A	N/A	37.5	N/A
Inert gas	Gaseous	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
	Liquefied	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Organic peroxide	UD	0.75	(0.75)	N/A	0.1875	(0.1875)	N/A	0.1875	(0.1875)
	I	7.5	(7.5)	N/A	1.5	(1.5)	N/A	1.5	(1.5)
	II	75	(75)	N/A	75	(75)	N/A	15	(15)
	III	187.5	(187.5)	N/A	187.5	(187.5)	N/A	37.5	(37.5)
	IV	NL	NL	N/A	NL	NL	N/A	NL	NL
	V	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizer	4	0.75	(0.75)	N/A	0.1875	(0.1875)	N/A	0.1875	(0.1875)
	3	15	(15)	N/A	3	(3)	N/A	3	(3)
	2	375	(375)	N/A	375	(375)	N/A	75	(75)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizing Gas	Gaseous	N/A	N/A	2250	N/A	N/A	2250	N/A	N/A
	Liquified	N/A	(225)	N/A	N/A	(225)	N/A	N/A	N/A
Pyrophoric material	N/A	3	(3)	37.5	0.75	(0.75)	7.5	0	0
Unstable (reactive)	4	0.75	(0.75)	7.5	0.1875	(0.1875)	1.5	0.1875	(0.1875)
	3	7.5	(7.5)	75	1.5	(1.5)	15	1.5	(1.5)
	2	75	(75)	1125	75	(75)	1125	15	(15)
	1	NL	NL	NL	NL	NL	NL	NL	NL
Water reactive	3	7.5	(7.5)	N/A	7.5	(7.5)	N/A	1.5	(1.5)
	2	75	(75)	N/A	75	(75)	N/A	15	(15)
	1	NL	NL	N/A	NL	NL	N/A	NL	NL
Corrosive	Gaseous	N/A	N/A	(1215)	N/A	N/A	(1215)	N/A	N/A
	Liquified/Solid	(7500)	(750)	(225)	(7500)	(750)	(225)	(1500)	(150)
Highly Toxic	Gaseous	N/A	N/A	NP	N/A	N/A	NP	N/A	N/A
	Liquified/Solid	(15)	(15)	NP	(15)	(15)	NP	(4.5)	(4.5)
Toxic	Gaseous	N/A	N/A	(1215)	N/A	N/A	(1215)	N/A	N/A
	Liquified/Solid	(750)	(750)	(225)	(750)	(750)	(225)	(187.5)	(187.5)

Notes:

N/A = Not applicable
NL = No Limit
UD = Unclassified Detonable
NP = Not Permitted

Appendix B

DEKRA Aqueous Waste Stream Material Test Results

DEKRA Services, Inc.

113 Campus Drive,
Princeton, NJ 08540 USA
Phone: +1.609.799.4449
Email: process-safety-usa@dekra.com

To: Rebecca LeChevalier
Company: **EH2 Analytics**
E-mail: rlechevalier@eh2.com

From: Melissa Murray, Laboratory Coordinator
DEKRA Process Safety

September 11th 2023
Job#: 30986

ATTENTION:

MESSAGE:
Dear Ms. LeChevalier,

The results of the Dust Explosion Hazard and Flammability Testing for your **three** samples are as follows:

Sample Name	Explosibility Screening – Go/No Go Classification	Cleveland Open Cup – ASTM D92		Pensky-Martens Closed Cup – ASTM D93
		Flash Point Temperature	Fire Point Temperature	
a) 5% MEK W/Water	-	58°C	No Fire Point Observed*	16°C
b) 10% IPA W/Water	-	46°C	56°C	36°C
c) Ti Powder	Go (Explosible)	-	-	-

*sample begins to boil above 88C.

A full report with interpretation will be sent electronically. If you have any questions, please call our Laboratory Manager, Mr. Don B. Churchwell, at phone 609.799.4449, ext. 345 or via e-mail at don.churchwell@dekra.com.

Sincerely,

Victoria Goncalves
Laboratory Supervisor

Yuan Dai
Senior Laboratory Specialist